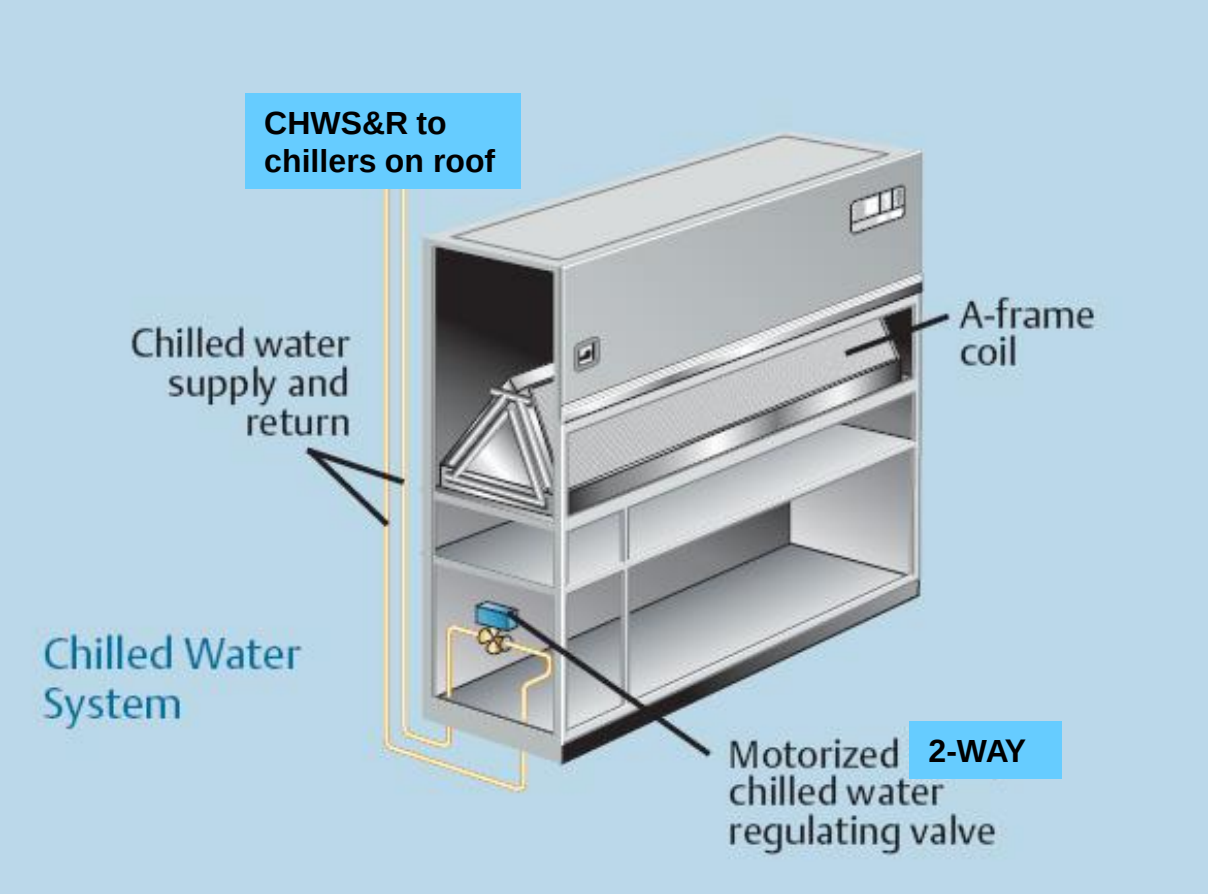
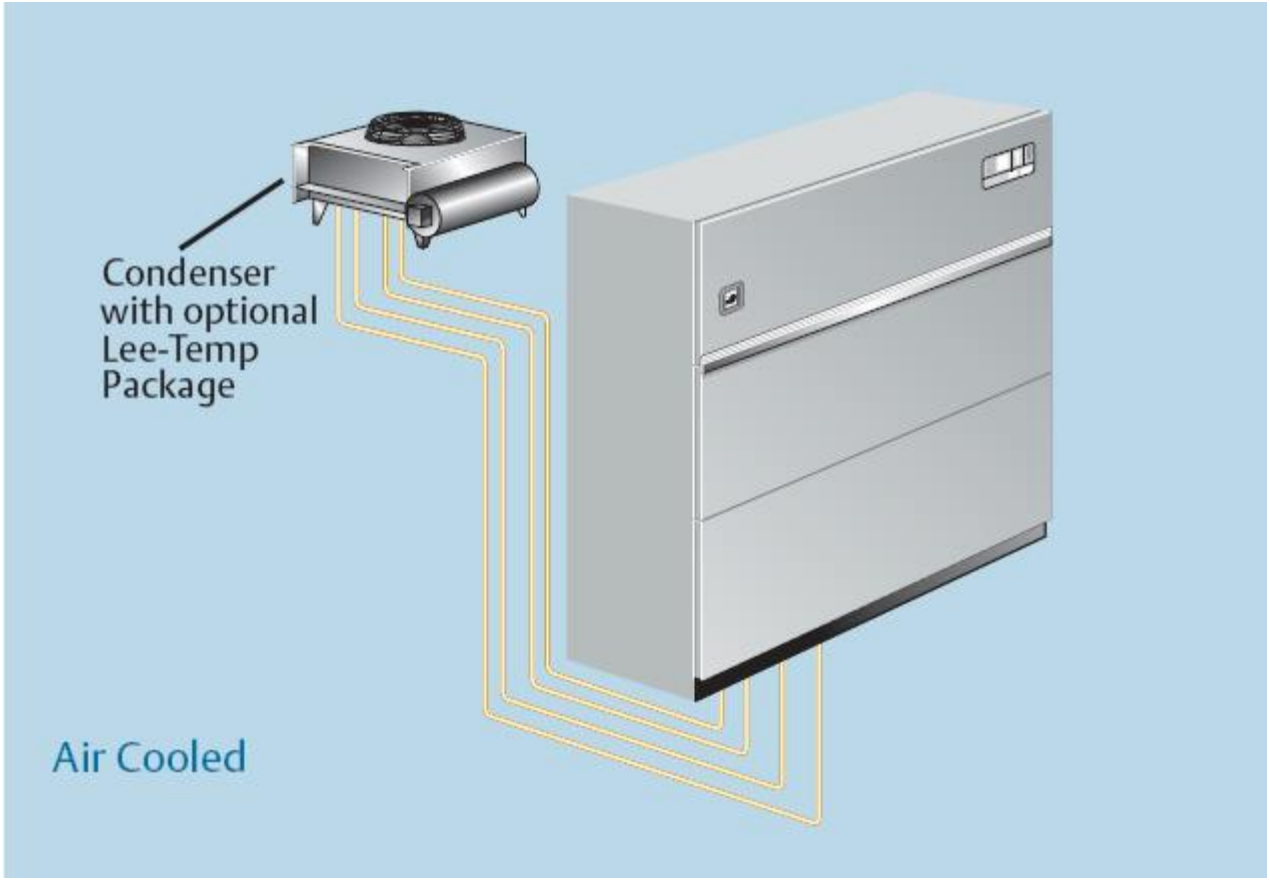
Air-Handler Systems

<Presenter>

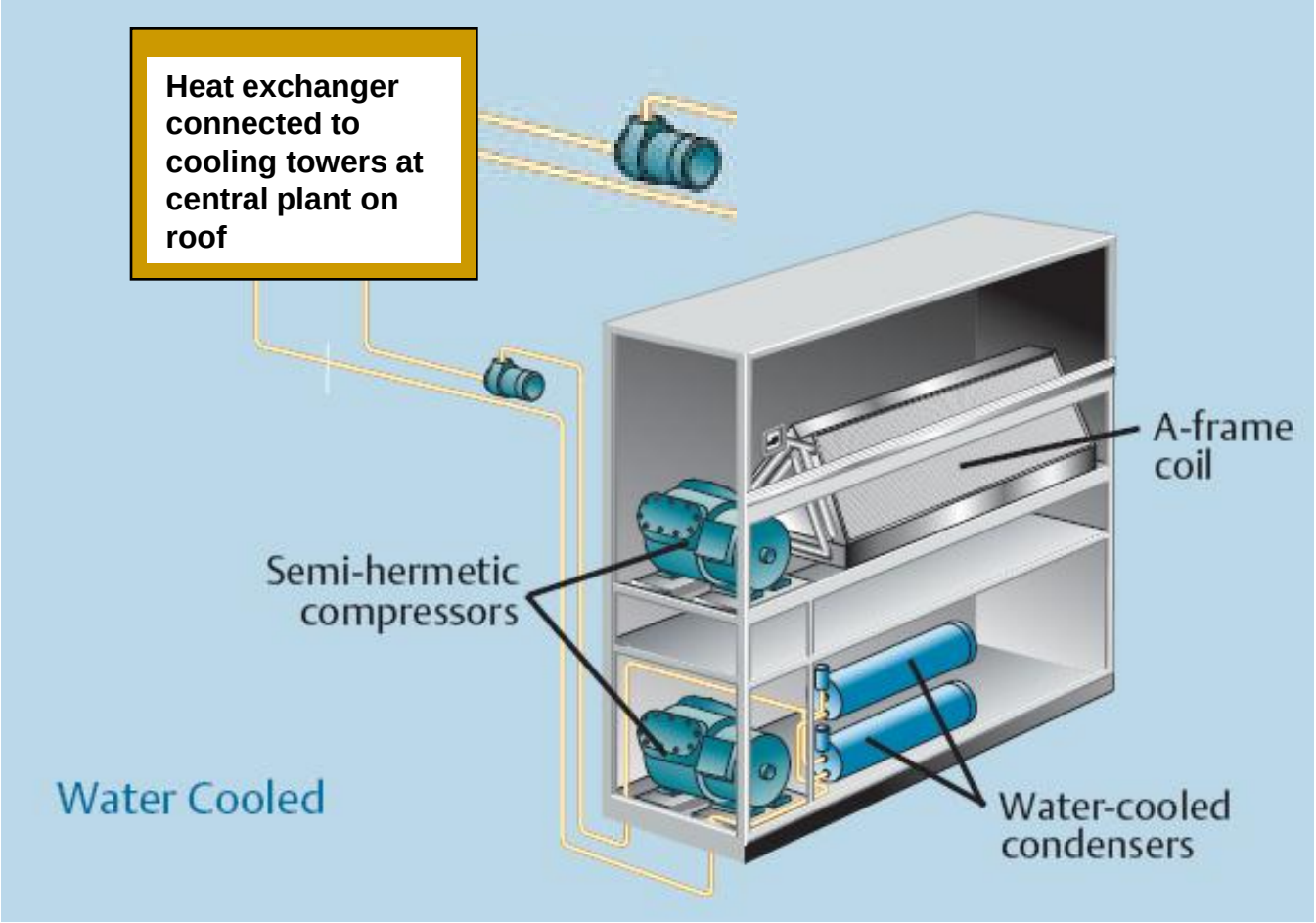
Chilled-Water CRAC Units



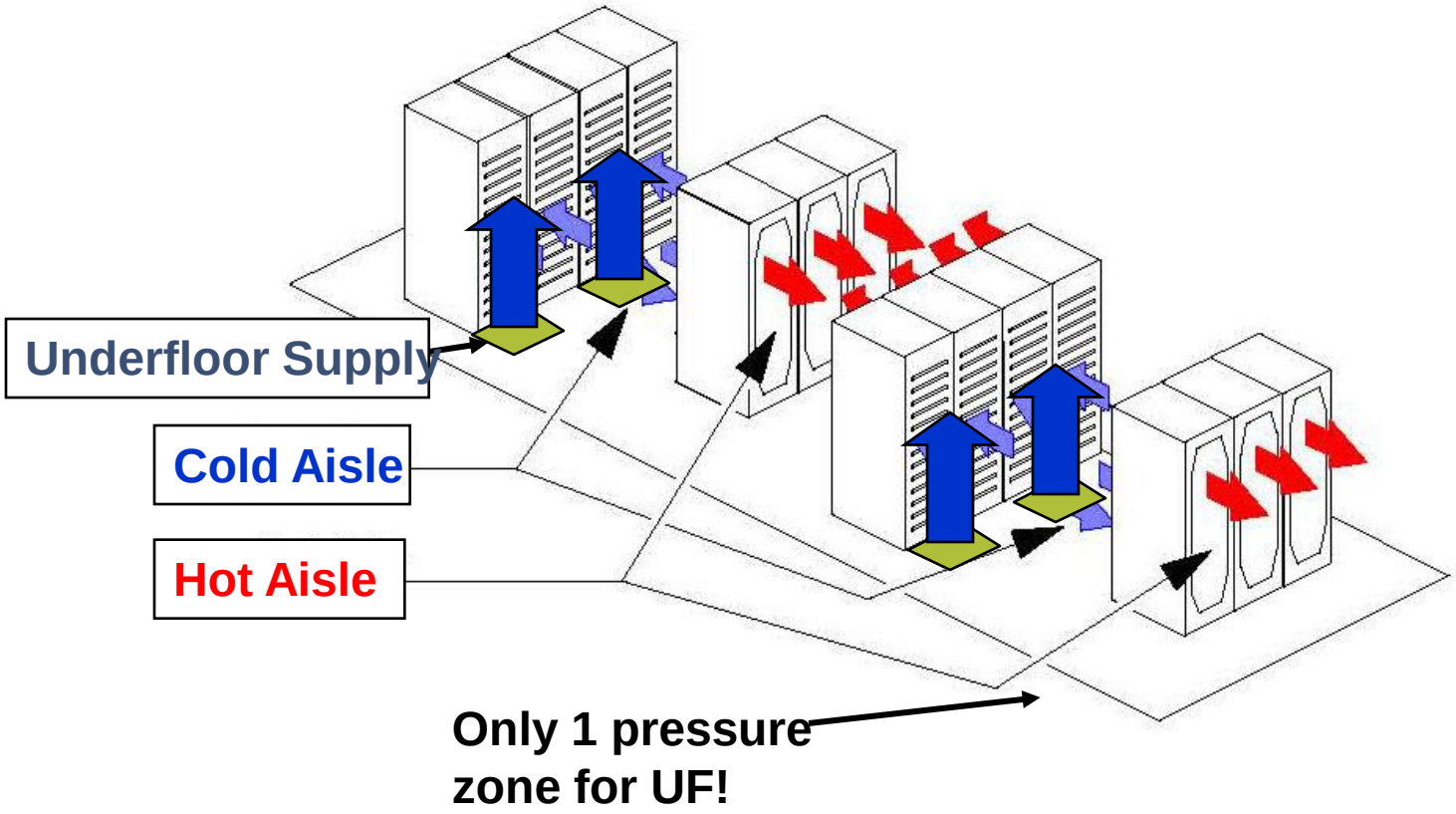
Split System Air Cooled CRAC Units



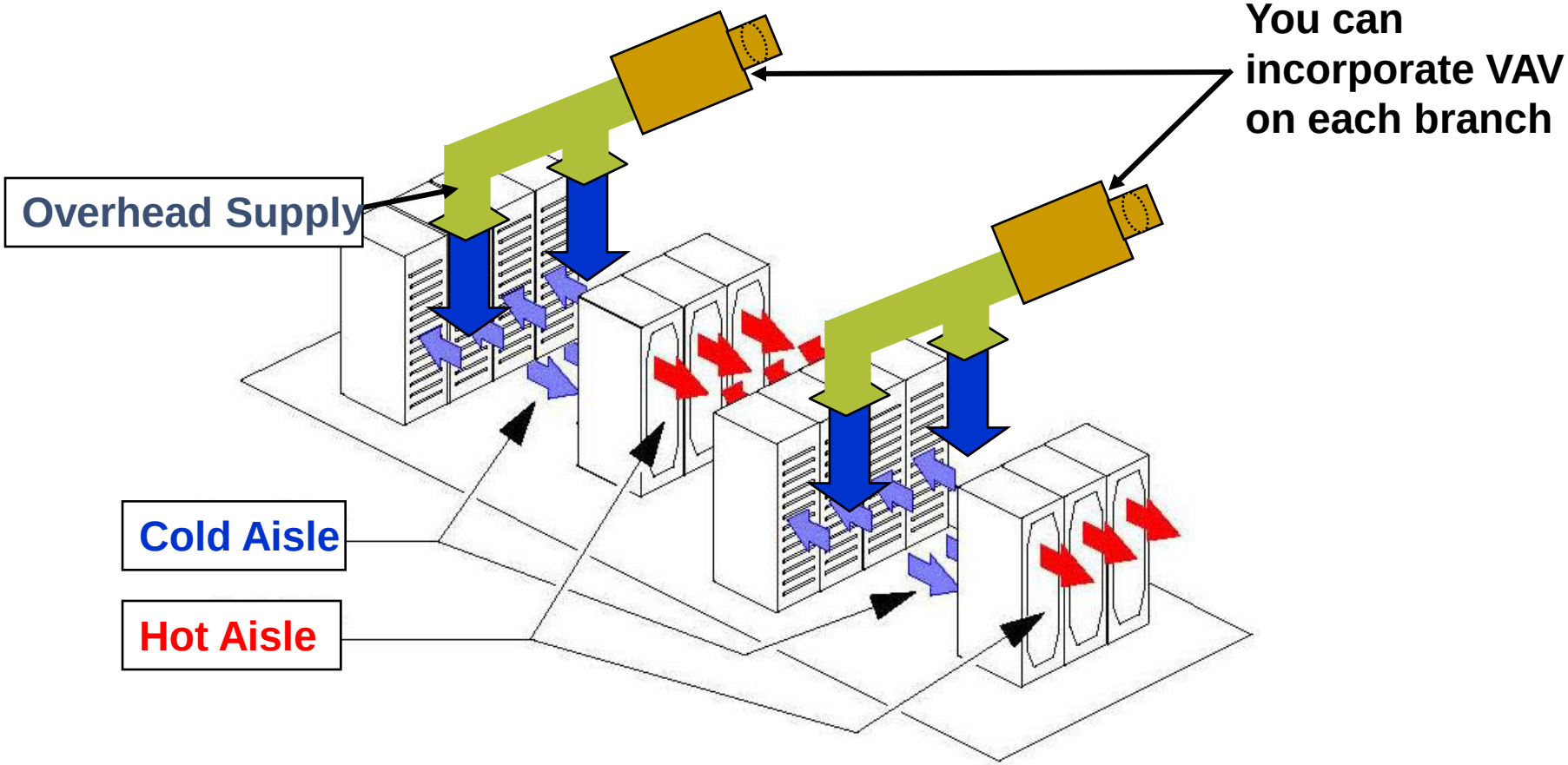
Water Cooled CRAC



Underfloor supply

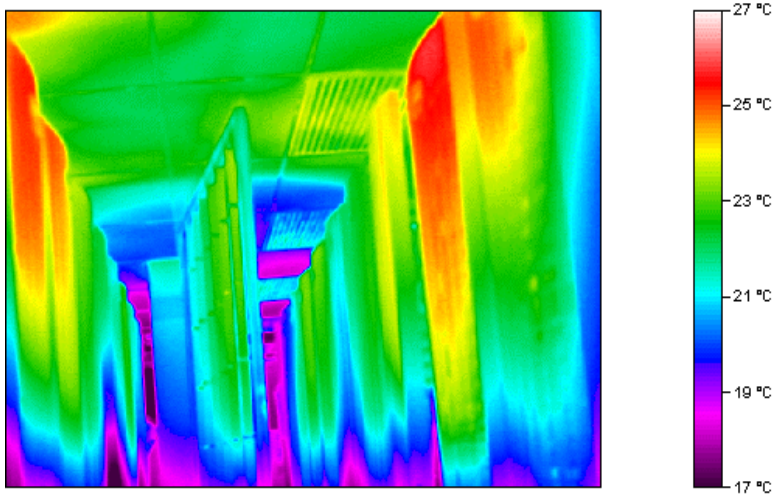


Overhead supply

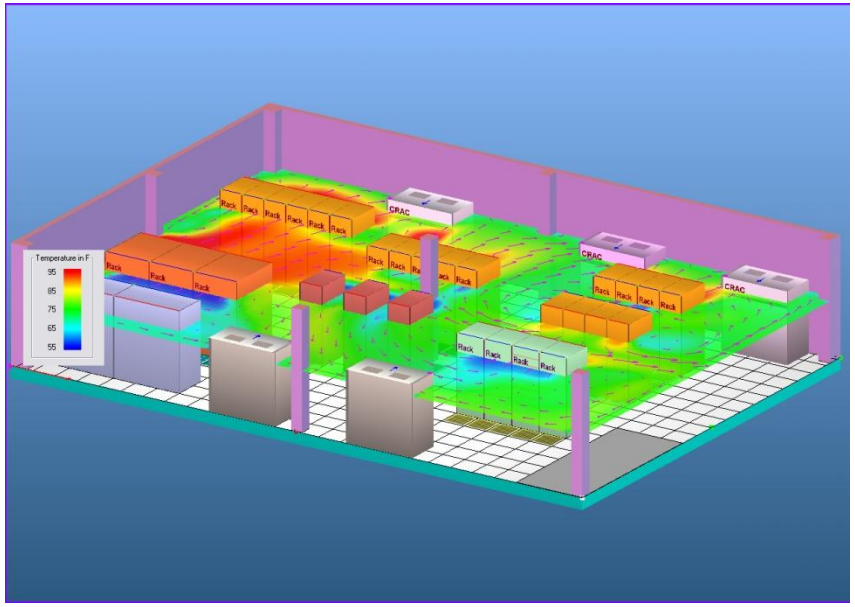


How Do You Balance Airflow?

- Spreadsheet
- CFD
- Monitoring, infrared thermography or other site measurements



Infrared thermographic image from LBNL

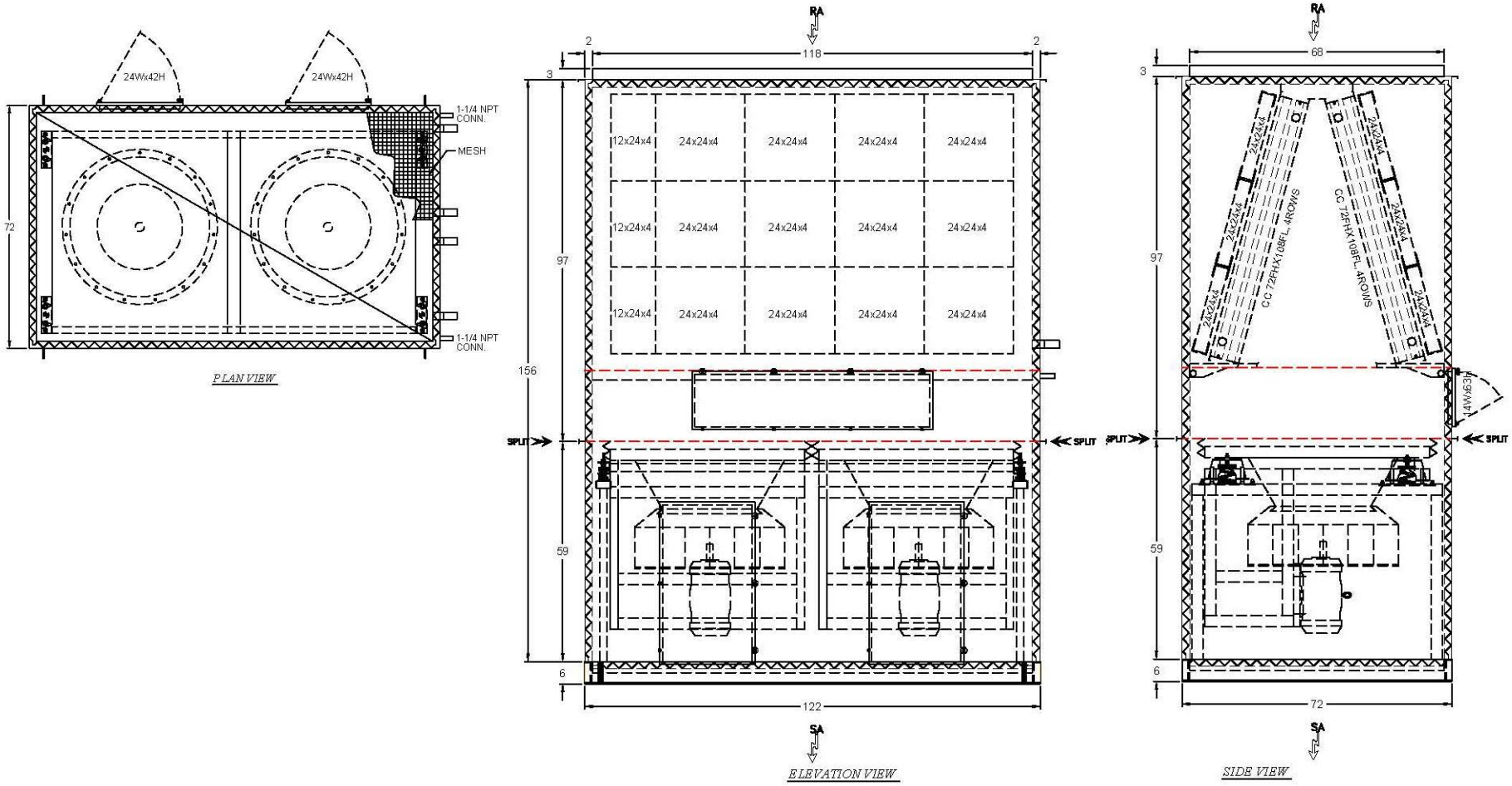


CFD image from TileFlow
http://www.inres.com/Products/TileFlow/tileflow.html,
Used with permission from Innovative Research, Inc.

Air system design overview

- Data center layout
- Airflow configurations
  - Distribution: overhead or underfloor
  - Control: constant or variable volume
- Airflow issues
- Economizers
- Humidity control issues

Custom CRAH Unit (Large)



Example custom CRAH unit comparison

	Option 1	Option 2	
Model	Std CRAC	Custom Model 1	Custom Model 2
Budget Cost	$ 16,235	$ 23,000	$ 41,000
Number of units	21	13	4
net total cooling (btuh)	434,900	410,000	841,000
net sensible (btuh)	397,400	399,000	818,000
sensible (tons)	33.1	33.3	68.2
CFM	16,500	25,000	50,000
SAT	49.90	59.30	59.00
airside dT	25.10	15.70	16.00
Internal SP	2	0.8	0.8
		1.8	1.8
no. fans	3	3	2
fan type	Centrifugal	Plenum	Plenum
no. motors	1	3	2
HP/motor	15	5	15
total HP	15	15	30
BHP/motor	15	4.7	11.5
Unit BHP	15	14.1	23
unit width	122	122	122
depth	35	36	72
height	76	156	168
filter type	ASHRAE 20%	MERV 13	MERV 13
Water PD (ft)	13.5 ft	11.1	11.1
CHW dT	14F	20	20
GPM	66.80	44.00	88.00
Total GPM	1,403	924	66%
Total BHP	315	275	87%

Example CRAH Unit Comparison

- 34% less water flow
- 13% less fan energy
  - More if you consider the supply air temperature and airflow issues
- Excess fan capacity on new units
- 36% higher cost for units, but
  - Fewer piping connections
  - Fewer electrical connections
  - Fewer control panels
  - No need for control gateway
  - Can use the existing distribution piping and pumps (case study)
  - Can use high quality sensors and place them where they make sense
- Possibly less turbulence at discharge?

Best HVAC Practices

- Air Management
- Air Economizers
- Humidification Control
- Centralized Air Handlers
- Low Pressure Drop Systems
- Fan Efficiency
- Cooling Plant Optimization
- Water Side Economizer
- Variable Speed Chillers
- Variable Speed Pumping
- Direct Liquid Cooling

Best Practices—Cross-Cutting and Misc. Issues

- Motor efficiency
- Right sizing
- Variable speed drives
- Lighting
- Maintenance
- Continuous Commissioning and Benchmarking
- Heat Recovery
- Building Envelope
- Redundancy Strategies
- Methods of charging for space and power

Best air delivery practices

- Arrange racks in hot aisle/cold aisle configuration
- Try to match or exceed server airflow by aisle
  - Get thermal report data from IT if possible
  - Plan for worst case
- Get variable speed or two speed fans on servers if possible
- Provide variable airflow fans for AC unit supply
- Consider using air handlers rather than CRACs for improved performance
- Use overhead supply where possible
- Provide aisle capping (preferably cold aisles, refer to LBNL presentation for more details)
- Plug floor leaks and provide blank off plates in racks
- Draw return from as high as possible
- Use CFD to inform design and operation

Airflow design disjoint

- IT departments select servers and racks – each having airflow requirements
- Engineers size the facility fans and cooling capacity
- What's missing in this picture?